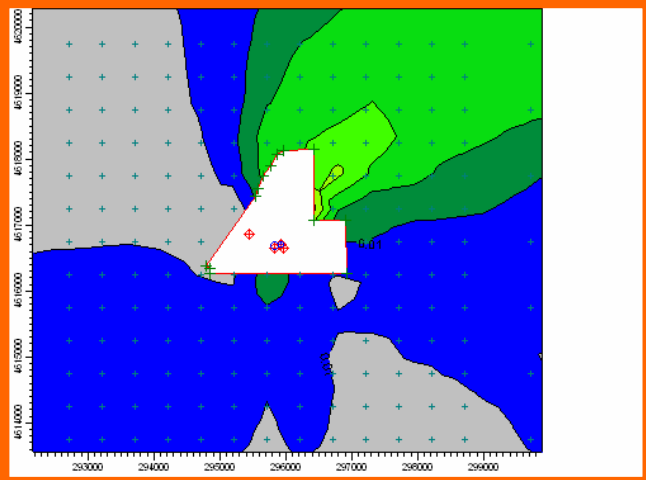
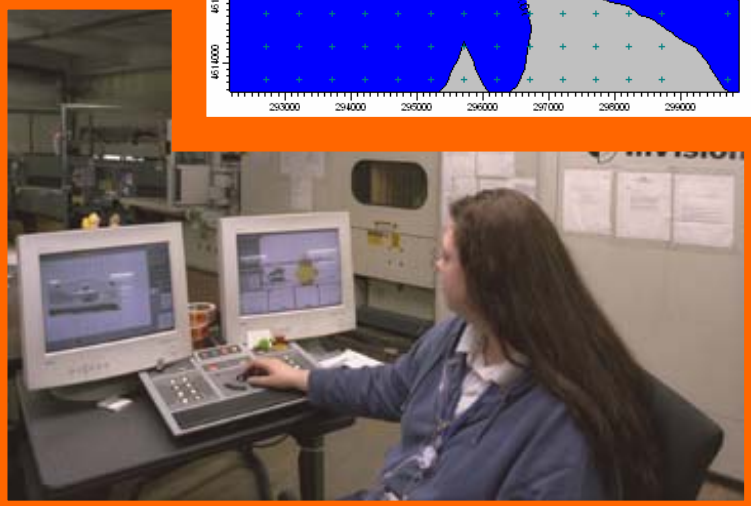




URS Tier 4 Aggregate Risk Modeling

"QUASAR":
Quantitative URS Approach to STAR Aggregate Risk

APCD Workshop #102

Presenter: Todd Royer

Thursday

March 16, 2006

Risk Goals vs. Model Output

The Aggregate Risk Modeling Challenge

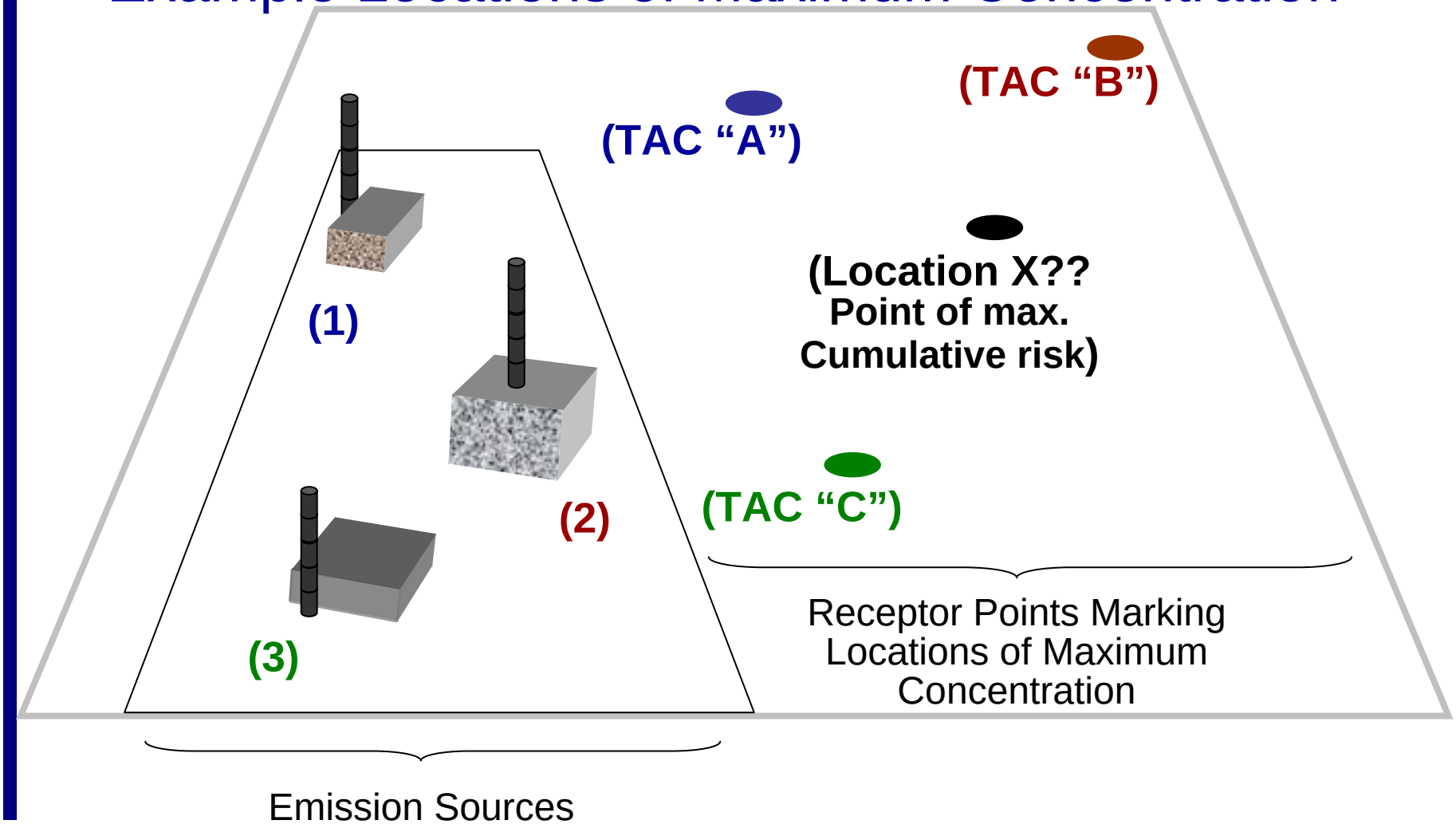
- STAR Requires Demonstrating Compliance with Risk Goal for Cumulative Risk of Multiple TACs/Multiple Release Points
- Tier 4 Models **Not** Designed to Consider Multiple Pollutant/Stack/Risk Simultaneously

Tier 4 (ISC/AERMOD) Model Capabilities/Characteristics

- Designed to model **one pollutant** (TAC) per "run"
- Single or Multiple Release Points
- Model Output = Ambient Concentration (**not Risk**)

  (Risk = ground level concentration divided by BAC)

Example Locations of Maximum Concentration



URS Approach to Rigorously Determine Cumulative Risk

- **URS's "Risk-Adjusted" Approach: "QUASAR"**
  - **Manipulate Model Input to let the Model Directly Determine the Maximum Cumulative Risk and its Location**

  Step 1: For each emission point: Convert the emission rate of each TAC emitted to a "risk-adjusted" emissions rate ***(based on a standardized surrogate TAC).***

  Step 2: For each emission point: Sum the standardized "risk-adjusted" emission rates to yield a single, total stack "risk-adjusted" emission rate.

  Step 3: Run Tier 4 model with "risk-adjusted" emissions rate from each stack.

  - **You're done – Model output directly identifies Max. Cumulative Risk and Location**
  - **Methodology is Easy to Do**

How and Why it Works! - Risk Modeling Theory

- **Tier 4 Models are Just Mathematical Functions**
  - Model Output = *f* (emission rate, release height, ACFM, exh. temp., etc)
- **For Each Release Point (& a given set of release parameters)**

  Model output is proportional to model input. For Emissions Rate:

  Double the input (g/s emiss. rate) yields double the output (Conc., μg/m3)
  - 2 g/s (Model Input) $\xrightarrow{Model}$ 1 $\mu g/m^3$ (Model Output)
  - 4 g/s (Model Input) $\xrightarrow{Model}$ 2 $\mu g/m^3$ (Model Output)
- **Conventionally - Risk Calculated Based on Model Output**
  - 4 g/s $\xrightarrow{Model}$ 2 $\mu g/m^3 \div$ 2 $\mu g/m^3$ (BAC_c) = 1.0 (Risk, 10^{-6})
- **Alternatively - Divide Input by BAC_c to Model Risk Directly**
  - 4 g/s $\div$ 2 $\mu g/m^3$ (BAC_c) = 2 $^{g/s}/_{\mu g/m^3}$ (Surr. Input) $\xrightarrow{Model}$ 1.0 (Risk, 10^{-6})

QUASAR Modeling Approach – Multiple TACs (Single Stack)

TAC	Emission Rate (g/s)	BAC ($\mu g/m^3$)		"Risk-Adjusted" Rate *Model Input* ($g/s / \mu g/m^3$)	Maximum Cumulative Risk *Model Output* (10^{-6})
A	2.0	÷ 20	=	0.1	
B	1.0	÷ 100	=	0.01	
C	0.02	÷ 1.0	=	0.02	
				0.13 *Model* →	0.65

- **Key Principal:**
  - Dividing an actual TAC emissions rate by its BAC_c yields a number equivalent to emissions rate of a "hypothetical" TAC with a BAC_c of 1 µg/m3 with a risk equivalent to actual TAC emissions.
- **URS Approach**
  - Effect is to Reduce Multiple TAC Emission Rates into a Single Surrogate "Risk-Adjusted" Emission Rate for each Source
  - Surrogate Rate Takes into Account Relative Toxicity
  - Model Output is ***Maximum Cumulative Risk***

Single Stack Example

Single Stack – Multiple TACs – Method Comparison

TAC	Emission Rate (g/s)	BAC ($\mu g/m^3$)		"QUASAR" "Risk-Adjusted" Rate *Model Input* ($g/s / \mu g/m^3$)	Maximum Cumulative Risk *Model Output* (10^{-6})
A	2.0	÷ 20	=	0.1	
B	1.0	÷ 100	=	0.01	
C	0.02	÷ 1.0	=	0.02	
				Total = 0.13 *Model* →	0.65

Conventional Method:

TAC	Emission Rate *Model Input* (g/s)		Max Concentration *Model Output* ($\mu g/m^3$)	BAC ($\mu g/m^3$)	Risk (10^{-6})
A	2.0	*Model* →	10.0	÷ 20	0.5
B	1.0	*Model* →	5.0	÷ 100	0.05
C	0.02	*Model* →	0.1	÷ 1.0	0.1
Conventionally Determined Maximum Cumulative Risk:					0.65

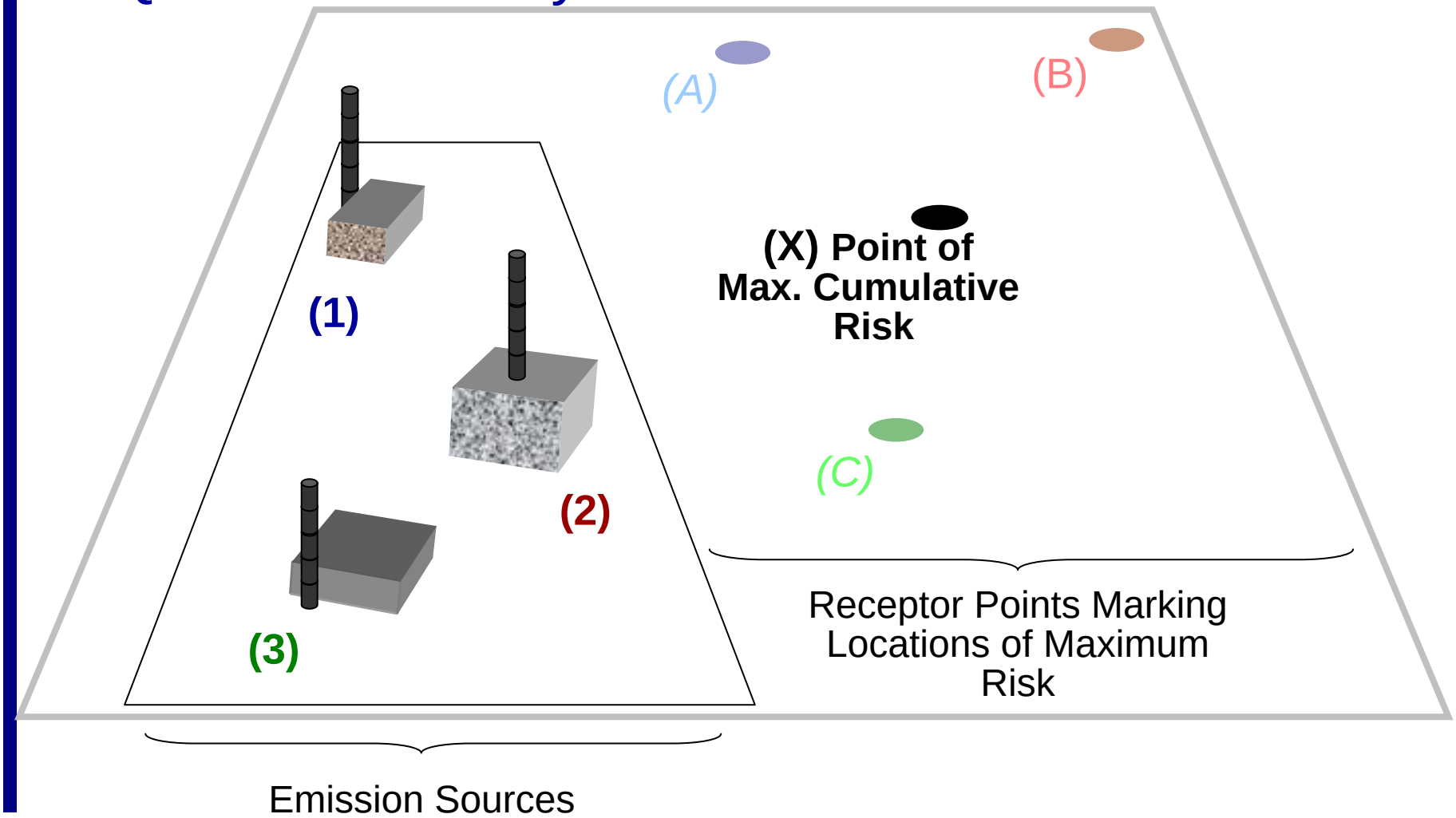
Multiple Stack Example

Multiple Stack – "Risk-Adjusted" Emission Rate

Stack	"Risk-Adjusted" Rate *Model Input* ($g/s / \mu g/m^3$)	Risk *Model Output* (10^{-6})
1	**0.13**	(Point A) 0.65
2	**0.01**	(Point B) 0.05
3	**0.02**	(Point C) 0.10
Sum of Individual Max Risks:		0.80
Maximum Cumulative Risk Modeling		**(Point X) 0.68**

- **URS's "QUASAR" Approach:**
  - Calculate a Surrogate "Risk-Adjusted" Emission Rate Based on BAC_c for Each Release Point
  - Use Surrogate "Risk-Adjusted" Emission Rate as the Single Pollutant in the Model
  - Model Directly Yields:
    - ✓ Maximum Cumulative Risk Impact from all Release Points

QUASAR Directly Determines Maximum Risk



Summary

- **STAR Requires Demonstrating Compliance with Risk Goal for Cumulative Risk of Multiple TACs/Multiple Release Points**
- **URS "Risk-Adjusted" Emissions Rate Approach:**
  - Calculate a Surrogate "Risk-Adjusted" Emission Rate Based on BAC_c for Each Release Point
  - Use Surrogate "Risk-Adjusted" Emission Rate in a Single Pollutant Model
  - Model Directly Yields Maximum Cumulative Risk Impact from all Release Points and all TACs
- **URS "QUASAR" Methodology:**
  - *Minimal Data Manipulation Needed – Simple Spreadsheet*
  - *Model Output Yields Maximum Cumulative Risk Directly*

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